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MONTHLY WEIGHT AND BALANCE REPORT

FOR THE APOLLO SPACECRAFT

CONTRACT NAS 9-150

(U)

1 MARCH 1963

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Prepared by:

WEIGHT CONTROL

[redacted]

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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INTRODUCTION

The March Report reflects a spacecraft weight decrease of 390 pounds at injection and 170 pounds at Service Module burnout.

The change in the Command Module was due primarily to the incorporation of Aerodynamic strakes as a solution to the two point stability problem and due to a decrease in ablation material consistent with the heat absorbtion capability of the structure.

The major changes in the Service Module during February occurred in the structure. The radial beams were modified to incorporate six machined beams in lieu of two honeycomb and four machined beams. The aft bulkhead honeycomb panel and tank cover has been reduced due to design refinements.

The Launch Escape System weight decrease is due to ballast reduction consistent with a lighter Command Module.

The current injected weight of 82210 pounds is based on the Service Module loaded with sufficient propellant at a specific impulse of 319.5 to provide 10 percent $\triangle$ V margin. This is also based on a LEM weight, including crew, of 25000 pounds.

The earth orbital mission weight summary reflects a two stage booster to orbit injection without the use of Service Module propulsion and is based on a complete Service Module loaded with 2440 pounds of propellant.

APOLLO LOR MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT.^{2})		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	8990	1043.8	0.5	7.9	4186	3571	3569
SERVICE MODULE - Less Propellant	9780	911.6	0.0	0.4	6524	12017	11874
TOTAL - Less Propellant	18770	974.9	0.2	4.0	10767	33315	33113
PROPELLANT - S/M**	35870	904.7	7.0	-3.0	18500	19400	25100
TOTAL - With Propellant	54640	928.8	4.7	-0.6	29519	65958	71448
LUNAR EXCURSION MODULE	24460	623.0	0.0	0.0	13616	12776	13247
ADAPTER - LEM - C-5	3110	640.1	0.0	0.0	6991	8599	8599
TOTAL - Injected	82210	826.9	3.1	-0.4	50214	452823	458868
LAUNCH ESCAPE SYSTEM	6400	1294.5	0.0	0.0	219	7691	7691
TOTAL - Spacecraft Launch	88610	860.7	2.9	-0.4	50445	740731	746788

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

**The propellant weight of 35870 pounds provides approximately 10% $\triangle$ V margin, and excludes 210 pounds of $\triangle$ V propellants tanked in the service module reaction control system.

APOLLO EARTH ORBIT MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT^2)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	8990	1043.8	0.5	7.9	4186	3571	3569
SERVICE MODULE - Less Propellant	9780	911.6	0.0	0.4	6524	12017	11874
TOTAL - Less Propellant	18770	974.9	0.2	4.0	10767	33315	33113
PROPELLANT - S/M**	2440	849.0	27.0	-11.7	770	500	600
TOTAL - With Propellant	21210	960.4	3.3	2.2	11986	41319	41436
ADAPTER - C-1	630	779.8	0.0	0.0	545	599	599
TOTAL - Injected	21840	955.2	3.2	2.1	12533	46227	46345
LAUNCH ESCAPE SYSTEM	6400	1294.5	0.0	0.0	219	7691	7691
TOTAL - Spacecraft Launch	28240	1032.1	2.5	1.6	12768	176899	177022

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

**The earth orbital weights are based on a complete service module and include 2,440 pounds of propellant for an orbital altitude of about 130 nautical miles with a payload launch azimuth of 72°.

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APOLLO LAUNCH ABORT CONFIGURATION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT^2)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	8990	1043.8	0.5	7.9	4186	3571	3569
LAUNCH ESCAPE SYSTEM	6400	1294.5	0.0	0.0	219	7691	7691
TOTAL - Launch Abort	15390	1148.0	0.3	4.6	4456	62014	61962
LESS - MAIN AND PITCH MOTOR PROPELLANTS	-3210	1296.0	0.0	0.0	-69	-1330	-1330
TOTAL - LES Burnout	12180	1108.9	0.4	5.8	4368	41357	41323

NOTE: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

COMMAND MODULE

WEIGHT AND CENTER OF GRAVITY SUMMARY

VEHICLE CONFIGURATION	LAUNCH ABORT CONDITION				ENTRY CONDITION (LUNAR MISSION)			
	WEIGHT	X	Y	Z	WEIGHT	X	Y	Z
Earth Launch	8990	1043.8	0.5	7.9	8990	1043.8	0.5	7.9
Add: Unexpended Waste & Water	-	-	-	-	63			
Shift Crew to Entry Position	-	-	-	-				
Prior to Entry	-	-	-	-	9053	1043.9	-0.1	9.8
Less: Propellant, RCS	-	-	-	-	-258	1022.6	-5.3	56.4
Ablation Material Burnoff	-	-	-	-	-283	1019.7	0.0	11.2
Nose Cone & Discone Antenna	-409*	1099.6	-0.1	1.4	-381	1098.0	-0.1	1.4
Drogue Chute	-25	1090.0	11.0	-22.0	-25	1090.0	11.0	-22.0
Entry Cooling Water	-	-	-	-	-6	1022.5	-23.4	60.7
Prior to Main Chute Deployment	8556	1041.0	0.5	8.3	8100	1042.8	0.0	8.7
Less: Main Parachutes (3)	-440	1089.9	0.3	6.7	-440	1089.9	0.3	6.7
Shift Crew to Landing Position								
Landing	8116	1038.3	0.5	8.5	7660	1040.0	0.0	7.6

*Represents nose cone with ablative material intact (no burnoff).

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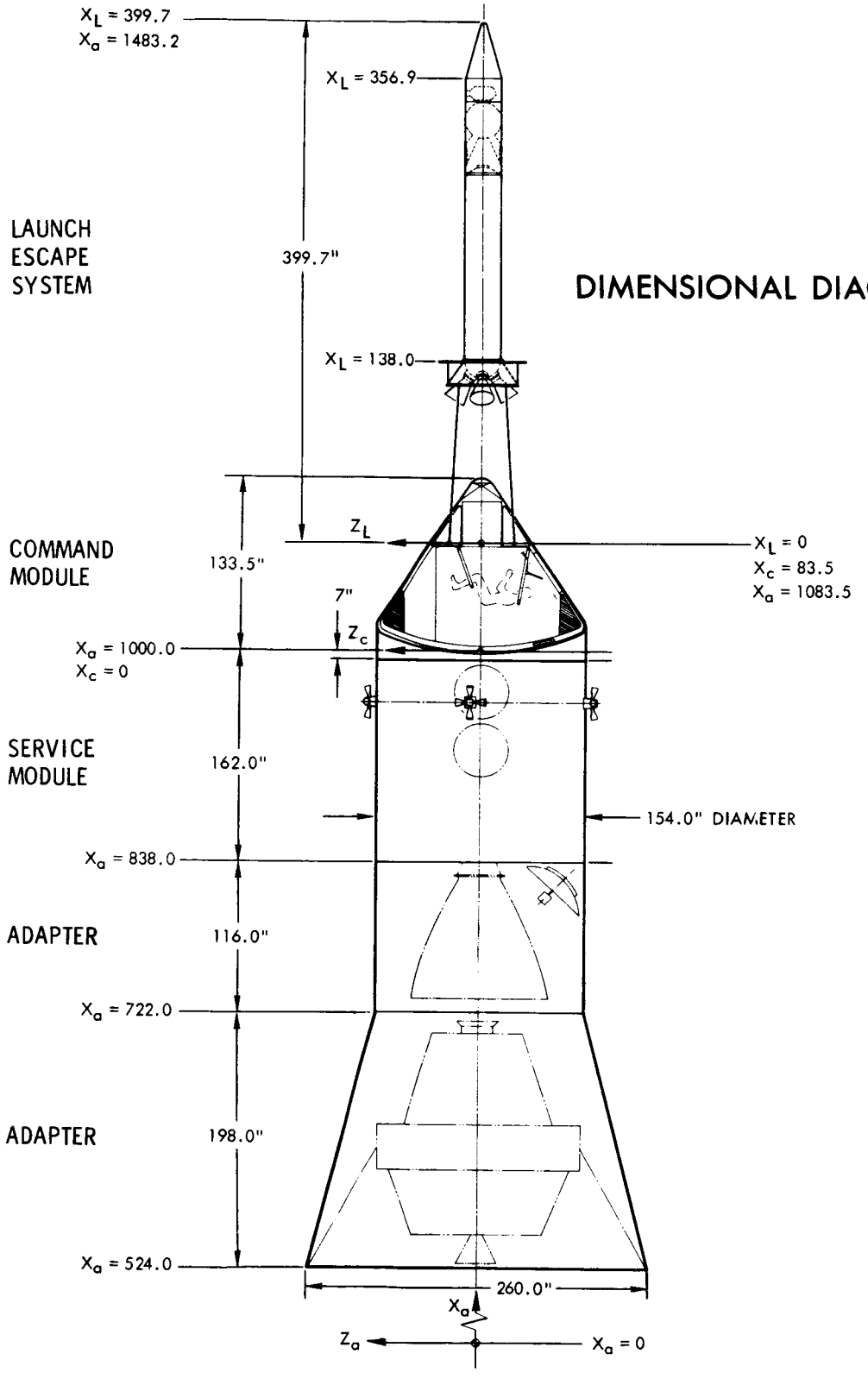
DIMENSIONAL DIAGRAM



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SPACECRAFT

WEIGHT STATUS SUMMARY

ITEM	PREVIOUS STATUS 2-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 3-1-63	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
COMMAND MODULE	9020	-30	8990	63	35	2
SERVICE MODULE*	54920	-140	54780	7	93	
LES	6430	-30	6400	41	59	
ADAPTER	3110		3110	100		
TOTAL	73480	-200	73280	21	79	-

NOTE: *Maximum capacity usable propellant of 45000 pounds included in status.

COMMAND MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 2-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 3-1-63	BASIS FOR CURRENT		
				%EST	%CAL.	%ACT.
Structure	4032	-50	3982	54	46	
Crew Systems	512		512	100		
Communication and Instrumentation	884	+5	889	100		
Guidance and Navigation	412	-8	404	100		
Stabilization and Control	233		233	100		
Reaction Control	294		294	84	16	
Electrical Power	417	+13	430	100		
Environmental Control	265	+7	272	100		
Earth Landing	556	+7	563	11	64	25
WEIGHT EMPTY	7605	-26	7579	69	29	2
Crew (3) (50, 70, 90 Percentile)	528		528		100	
Suits and Personal Equipment	136	-2	134	100		
Survival Water	18	-18	0			
Food and Containers	90		90	100		
Reaction Control Propellant	242	+16	258		100	
Environmental Control Chemicals	151		151		100	
Scientific Payload	250		250	100		
GROSS WEIGHT	9020	-30	8990	63	35	2

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

STRUCTURE		(-50.0)
Increase heat shield structure due to the following:		+60.0
Addition of aerodynamic strakes as a solution to the two point stability problem.	+42.0	
Reduction of tower well fittings based on estimate of redesign.	-12.0	
Addition of hinge and latch mechanism for egress capability in forward hatch.	+5.0	
Increase in skin gauge for rendezvous window cover in order to reduce effect of deflections on the present latching mechanism.	+25.0	
Decrease inner structure due to the following:		-22.0
Redesign of parachute fittings for incorporation of titanium in lieu of steel and to reflect the results of a revised load path analysis.	-28.0	
Increase in side window frame for latching mechanism provision.	+3.0	
Increase due to detail calculations in lieu of estimated weights.	+3.0	
Decrease ablation material based on heat capability analysis of structure as reported in the Avco February Status.		-88.0
COMMUNICATION AND INSTRUMENTATION		(+5.0)
Incorporate HF transceiver and VHF-FM transmitter into a single package termed VHF FM transmitter/HF transceiver.		+15.9
Incorporate VHF AM transmitter-receiver and VHF recovery beacon into a single package termed VHF AM transmitter-receiver/VHF recovery beacon.		+16.0

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

COMMUNICATION AND INSTRUMENTATION (CONTINUED)

Delete the following components due to repackaging into components described above:	
VHF FM Transmitter	-5.7
VHF AM Transmitter-Receiver	-9.3
HF Transceiver	-10.0
VHF Recovery Beacon	-6.5
Increase multiplexer due to incorporation of antenna switch formerly included with remote equipment.	+2.0
Increase signal conditioner due to incorporation of input analog patch, digital patch panel and output analog patch formerly listed as separate items.	+9.2
Delete the following items due to incorporation into the signal conditioner:	
Input Analog Patch	-2.6
Digital Patch Panel	-4.0
Output Analog Patch	-2.6
Increase recorder due to incorporation of three additional rolls of spare tape.	+7.0
Decrease central timing equipment due to incorporation of calculated data in lieu of estimated data per vendor quotation.	-2.0
Decrease remote equipment due to incorporation of the VHF/2-KMC omni antenna switch into the multiplexer.	-2.0
Decrease remote equipment due to revised estimate of the VHF recovery antenna and transmission.	-0.4

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

GUIDANCE AND NAVIGATION		(-8.0)
Decrease display and control - navigation for incorporation of drawing calculations in lieu of layout estimates as reflected by the MIT February Status.		-8.0
Revise the following due to miscellaneous design changes as reflected by the MIT February Status.		
Inertial Platform	+0.3	
Cabling	-0.3	
ELECTRICAL POWER		(+13.0)
Increase inverter due to calculation of layouts in lieu of estimates from parametric data as reflected in the discussions with Westinghouse.		+12.0
Increase sequencer due to the following:		+10.0
Transfer weight previously allocated to common utility separation systems for this function.	+8.5	
Increase due to revised estimates based on the current requirements for a solid state device.	+1.5	
Decrease common utility provisions due to the following:		-8.8
Increase in umbilicals due to miscellaneous changes.	+0.1	
Decrease of adapter, launch escape system and Service Module separation provisions as these functions are accomplished by the sequencer.	-8.9	
Decrease installation provisions due to miscellaneous changes.		-0.2
ENVIRONMENTAL CONTROL		(+7.0)
Increase subcontractor heat exchanger due to repackaging utilizing steel in lieu of aluminum:		+4.7
Pressure Suit Circuit	+3.2	
Pressure and Temperature Control	+1.5	

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COMMAND MODULE

CURRENT WEIGHT EMPTY CHANGES

ENVIRONMENTAL CONTROL (CONTINUED)	
Increase subcontractor water tanks due to the addition of bosses.	+0.6
Increase subcontractor brackets, plumbing electrical wiring based on revised estimates from layouts.	+1.3
Increase NAA equipment supports due to miscellaneous changes.	+0.4
EARTH LANDING SYSTEM	(+7.0)
Increase drogue disconnect installation due to analysis of layouts for the single drogue system and due to the addition of bushings and explosive bolts.	+8.9
Decrease sequence control due to changes in the relay assembly, baroswitches and inertia switches.	-2.1
Increase electrical pyrotechnic initiation provisions due to miscellaneous design changes.	+0.2
TOTAL COMMAND MODULE WEIGHT EMPTY CHANGES	-26.0

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COMMAND MODULE

CURRENT USEFUL LOAD CHANGES

Decrease crew systems medical equipment due to deletion of biomedical instrumentation as this function included in the NASA furnished instrumentation.	-2.0
Decrease crew systems due to deletion of survival water as sufficient water for survival is included in survival kit.	-18.0
Increase reaction control propellant in order to maintain required impulse with incorporation of RCS engine expansion ratio change from 40:1 to 10:1. For cost saving reasons the Command Module RCS propellant tank diameters have been standardized with the Service Module RCS tank diameters at 12.5 inches.	+16.0
TOTAL COMMAND MODULE CURRENT USEFUL LOAD CHANGES	-4.0

SERVICE MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 2-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 3-1-63	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
Structure	2623	-132	2491	80	20	
Electronics	166	-15	151	100		
Reaction Control	599	-2	597	84	16	
Electrical Power	1151	+9	1160	25	75	
Environmental Control	78		78	100		
Propulsion System						
Engine Installation	640		640	85	15	
Propellant System	2422		2422	16	84	
WEIGHT EMPTY	7679	-140	7539	52	48	
Usable RCS Propellant	790		790		100	
Usable Supercritical Reactants	459		459		100	
Environmental Control Fluids	208		208		100	
Main Propulsion Helium	99		99		100	
Main Propellant Residuals	(617)		(617)		100	
Trapped - System	225		225			
Trapped - Engine	67		67			
Mixture Ratio Tolerance	100		100			
Loading Tolerance	225		225			
Unusable RCS Propellant	45		45		100	
Unusable Supercritical Reactants	23		23		100	
BURNOUT WEIGHT	9920	-140	9780	40	60	
Main Propellant (Maximum Usable Capacity)	45000		45000		100	
GROSS WEIGHT	54920	-140	54780	7	93	

[redacted]

SERVICE MODULE

CURRENT WEIGHT EMPTY CHANGES

STRUCTURE	(-132.0)
Decrease radial beams due to incorporation of six machined beams in lieu of two honeycomb and four machined beams; and due to a decrease in loads.	-50.0
Increase radial beams due to calculation of revised layouts of the Command Module support pads.	+9.0
Increase Command Module to Service Module fairing due to the addition of an aerodynamic fairing for the relocated electrical umbilical.	+10.0
Increase forward bulkhead web splices based on calculation of released drawings in lieu of estimation of layouts.	+2.0
Increase forward bulkhead outer ring due to the addition of steel doublers for splicing across radial beams.	+5.0
Decrease aft bulkhead honeycomb panel due to a reduction in thickness of the chem-milled face sheets reflected in the calculation of released drawings.	-50.0
Decrease aft bulkhead rings based on calculation of released drawings in lieu of estimation of layouts.	-19.0
Decrease aft bulkhead tank cover based on calculation of revised layouts.	-39.0
ELECTRONICS	(-15.0)
Decrease instrumentation due to the deletion of the signal conditioner, as the signal conditioning for the Service Module instrumentation will be accomplished by the electronic equipment located in the Command Module.	-15.0
REACTION CONTROL SYSTEM	(-2.0)
Decrease pressure system due to the deletion of four pressure sensors.	-2.0
ELECTRICAL POWER	(+9.0)
Increase fuel cell power pack due to the incorporation of signal conditioning equipment per February status from Pratt and Whitney.	+1.5

[redacted]

[redacted]

SERVICE MODULE

CURRENT WEIGHT EMPTY CHANGES

ELECTRICAL POWER - (CONTINUED)

Increase fuel cell hydrogen supercritical storage system due to additional insulation as well as miscellaneous design changes per Beech January Status.	+5.0
Increase power distribution supports based on revised estimate of preliminary layouts.	+0.5
Increase electrical utilities based on revised estimates of layouts and additional design data.	+2.0
TOTAL SERVICE MODULE CURRENT WEIGHT EMPTY CHANGES	-140.0

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LAUNCH ESCAPE SYSTEM

WEIGHT STATUS

ITEM	PREVIOUS STATUS 2-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 3-1-63	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
Structure	1072	-1	1071	13	87	
Electrical System	20		20	100		
Propulsion System						
Main Thrust	4764		4764	50	50	
Jettison	440		440	1	99	
Pitch Control	55		55	75	25	
LES - NO BALLAST	6351	-1	6350	41	59	
BALLAST	79	-29	50	100		
TOTAL L.E.S.	6430	-30	6400	41	59	

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LAUNCH ESCAPE SYSTEM

CURRENT WEIGHT CHANGES

STRUCTURE	(-1)
Incorporate the following weight changes based on calculation of released drawings in lieu of estimation of layouts:	
Tower Assembly	-3
Nose Cone and Ballast Support	-1
Attaching Parts	+3
BALLAST	(-29)
Decrease ballast weight consistent with combined Command Module and Launch Escape System balance requirements.	-29
TOTAL LAUNCH ESCAPE SYSTEM CURRENT WEIGHT CHANGES	-30

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ADAPTER

WEIGHT STATUS

ITEM	PREVIOUS STATUS 2-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 3-1-63	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
Structure	2892		2892			
Electrical	76		76			
Separation System	142		142			
TOTAL ADAPTER	3110		3110	100		

[redacted]

WEIGHT HISTORY COMMENTS

LAUNCH ESCAPE SYSTEM

The target weight established for the LES is 6,300 pounds, excluding ballast. This weight was based on the September status weight of 6,600 pounds including the necessary ballast to provide currently determined Aerodynamic stability to prevent tumbling.

The original target of 5,900 pounds as reported in the June Status, SID 62-99-5, was based on an attitude controlled configuration. The current configuration weight includes a flow separator, pitch motor, and ballast not included in the original target weight.

COMMAND MODULE

The target weight established for the Command Module is 8,500 pounds. An estimated weight breakdown for the target weight is provided for comparative purposes.

The original target weight of 8,340 pounds as reported in the June Status, SID 62-99-5, did not include the proposed increases nor the category I reductions presented in the July briefing and incorporated in the July Status Report.

SERVICE MODULE

The target weight established for the Service Module less usable propellant is 11,000 pounds. An estimated weight breakdown for the target weight is provided for comparative purposes. This configuration is sized for 45,000 pounds usable propellant for the 25,000 pound LEM.

The original target weight of 8,675 for the burnout condition was based on a lunar landing configuration sized for 31,000 pounds usable propellant.

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WEIGHT HISTORY

COMMAND MODULE

	ORIGINAL TARGET WT.	TARGET WEIGHT	AUTHORIZED CHANGES	AUTHORIZED WEIGHT 3-1-63
Structure	3670	3720		3720
Crew Systems	565	690	+2	692
Communication & Instrumentation	944	785		785
Guidance & Navigation	310	310	+78	388
Stabilization & Control	175	195		195
Reaction Control	183	195		195
Electrical Power	354	390		390
Environmental Control	228	255		255
Earth Landing	530	610	-106	504
WEIGHT EMPTY	6959	7150	-26	7124
Crew	528	528		528
Suits & Personal Equipment	82	126		126
Survival Water	54	18		18
Food & Containers	90	90		90
Reaction Control Propellant	210	210		210
Environmental Control Fluids	167	128		128
Scientific Payload	250	250		250
GROSS WEIGHT	8340	8500	-26	8474

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COMMAND MODULE WEIGHT HISTORY

WEIGHT EMPTY AUTHORIZED CHANGES

COMMUNICATION & INSTRUMENTATION	(+2)
Add a loudspeaker in the crew compartment per NASA request.	+2
GUIDANCE & NAVIGATION	(+78)
Increase the Guidance and Navigation per recent weight report from M.I.T. Since NAA does not have weight control responsibility for the M.I.T. Design, the weight changes in their Weight and Balance Report will be considered as authorized changes.	+78
EARTH LANDING	(-106)
The removal of the impact attenuation system per TWX SM 032, dated 23 July 1962 was reported in the 1 November 1962 Weight and Balance Report.	-106
TOTAL COMMAND MODULE WEIGHT EMPTY CHANGES	-26

[redacted]

WEIGHT HISTORY

SERVICE MODULE

	ORIGINAL TARGET WT.	TARGET WEIGHT	AUTHORIZED CHANGES	AUTHORIZED WEIGHT 3-1-63
Structure	2810	3203		3203
Electronics	216	145		145
Reaction Control	254	737		737
Electrical Power	1076	1203		1203
Environmental Control	413	250		250
Propulsion System				
Engine Installation	375	606		606
Propellant System	1928	2456		2456
WEIGHT EMPTY	7072	8600		
Usable RCS Propellant	400	611		611
Usable Fuel Cell Reactants	380	479		479
Environmental Control Fluids	288	193		193
Main Propulsion Helium	97	139		139
Main Prop. Residuals	300	900		900
Unusable RCS Propellant	20	61		61
Unusable Fuel Cell Reactants	38	17		17
BURNOUT WEIGHT	8595	11000		11000
Main Propellant	31000	45000		45000
GROSS WEIGHT	39595	56000		56000

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POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGES

COMMAND MODULE

STRUCTURE	(+42)
Decrease strake lands in forward compartment and crew compartment based on reduced loads.	-5
Increase frame weight due to completion of structural load analysis.	+30
Decrease bond foam utilized in core splicing due to design refinements.	-10
Decrease umbilical fitting due to incorporation of honeycomb attach panel in lieu of the existing steel plate. The steel plate is utilized currently due to the manufacturing schedule commitments.	-3
Increase crew hatch structure due to requirements for bridging structural loads around hatch.	+30
COMMUNICATIONS AND INSTRUMENTATION	(+15)
Increase signal conditioner to incorporate capabilities for conditioning instrumentation signal voltages originating in the Service Module.	+15
STABILIZATION AND CONTROL	(+15)
Increase M-H electronic control amplifier for incorporation of signal ground isolation.	+15
ELECTRICAL POWER SYSTEM	(-12)
Decrease inverter based on redesign of internal support structure.	-12
SCIENTIFIC EQUIPMENT	(-200)
Decrease scientific equipment weight at launch based on NASA comments that this equipment will likely be located in the LEM.	-200
LEM INTEGRATION	(+220)
Modify structure to incorporate mating and locking capabilities and to strengthen hatch for mating impact loads.	+90

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POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGES

COMMAND MODULE

LEM INTEGRATION (CONTINUED)	
Add electrical provisions for power distribution and control for LEM system activation.	+20
Add in-flight test wiring for LEM checkout.	+25
Modify 2KMC OMNI antenna and relocate.	+28
Add rendezvous beacon radar installation as an aid during the rendezvous phase.	+25
Add cooling water for subsequent transfer to the LEM.	+32
EARTH LANDING SYSTEM	(-105)
Increase parachute supports and attach structure to be compatible with increased structure loads imposed by the current ringsail parachutes.	+3
Decrease parachute weight consistent with incorporation of solid conical parachutes.	-105
Decrease parachute supports and attach structure due to reduced structure loads imposed by the proposed solid conical parachutes.	-3
TOTAL COMMAND MODULE POTENTIAL WEIGHT CHANGES	-25

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POTENTIAL WEIGHT AND C.G. CHANGES

SERVICE MODULE

STRUCTURE	(-64)
The removal of insulation from the radial beams may result from current Thermodynamics analysis.	-64
REACTION CONTROL SYSTEM	(+35)
Increase system for incorporation of provisions for RCS propellant quantity indication.	+35
USEFUL LOAD	(-35)
Revise loading tolerance weight to reflect the volume of propellant required for the lunar mission.	-35
TOTAL POTENTIAL WEIGHT CHANGES - SERVICE MODULE	-64

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

SUMMARY

ITEM		CURRENT WEIGHT 3-1-63
WEIGHT EMPTY		7579
Structure	3982	
Crew Systems	512	
Communication & Instrumentation	889	
Guidance & Navigation	404	
Stabilization & Control	233	
Reaction Control	294	
Electrical Power	430	
Environmental Control	272	
Earth Landing	563	
USEFUL LOAD		1411
Crew Systems	752	
Reaction Control	258	
Environmental Control	151	
Scientific Payload	250	
GROSS WEIGHT		8990

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

STRUCTURE

ITEM	CURRENT WEIGHT 3-1-63
STRUCTURE	
Heat Shield	(1341)
Forward Compartment	180
Crew Compartment	702
Aft Compartment	459
Inner Structure	(942)
Forward Section	181
Forward Sidewall	358
Aft Sidewall	207
Aft Bulkhead	196
Secondary Structure	(253)
Ablation Material	(1260)
Microfiber Insulation	(186)
TOTAL STRUCTURE	3982

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

CREW SYSTEMS

ITEM	CURRENT WEIGHT 3-1-63
CREW SYSTEMS	
Personal Radiation Dosimeter (NASA)	5.0
Portable Life Support System (2)(NASA)	60.0
Personnel Communications (NASA)	5.0
Seat Liners & Restraint Harness	36.0
Sleeping Restraints	4.0
Waste Management	18.0
Lighting Equipment	15.0
Garments - Constant Wear (NASA)	9.0
Water Delivery Assy.	1.5
Survival Kit - Collective (1)	56.0
Shoe Straps (6 pr.)	2.0
Food Probe and Mouthpiece	4.0
Log Book, Pencils, etc.	1.0
Hatch Egress	3.0
Lap Board (2)	2.0
Manual - Maint. Maps, & Case	6.0
Suit Umbilical Hose (4)	10.0
In-Flight Test Maintenance Tool Belt	1.0
Structural Seats & Supports	258.0
Nuclear Radiation Detectors	7.0
In-Flight Maintenance Tool Set	1.0
Food Preparation Shelf	3.0
Personal Head Sets	4.5
TOTAL CREW SYSTEMS	512.0

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
COMMUNICATIONS & INSTRUMENTATION

ITEM	CURRENT WEIGHT 3-1-63
TELECOMMUNICATIONS	
Lower Bay	(239.0)
C-Band Transponder	16.0
Unified S-Band	25.0
S-Band Power Amplifier	20.5
VHF FM Transmitter/HF Transceiver	15.9
VHF AM Trans.-Rec./VHF Rec. Bea.	16.0
Multiplexer	11.0
Spares	19.0
PCM Telemetry Unit No. 1	26.0
PCM Telemetry Unit No. 2	25.0
Signal Conditioner	19.6
Recorder	22.0
Audio Center	5.0
Premodulation Processor	10.0
Central Timing Equipment	8.0
Remote Equipment	(146.0)
VHF/2-KMC OMNI Antenna & Transmission	57.0
HF Recovery Antenna & Transmission	15.0
C-Band Antenna & Transmission	18.0
VHF Recovery Antenna & Transmission	17.0
TV Camera	4.0
Instrumentation Sensors	35.0
Supports	(12.0)
Electrical Provisions	(96.0)
Electronic Interface Provisions	(8.0)
Cooling Provisions	(21.0)
TOTAL TELECOMMUNICATIONS (to be brought forward)	522.0

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
COMMUNICATION AND INSTRUMENTATION

ITEM		CURRENT WEIGHT 3-1-63
CONTROLS AND DISPLAYS		
Main Display Panel Control Station		(60.5)
Integrated Display	C&I	10.0
GMT Clock	C&I	0.7
Computer Data Insert & Display	G&N	15.0
Time to & from Clock	G&N	1.5
SCS Control Panel	SCS	6.0
Delta Velocity Control	SCS	2.5
Flight Director Attitude Indicator	SCS	10.5
Gimbal Angle Indicator	SCS	2.0
Barometric Indicator	SCS	1.8
Entry Monitoring Indicator	E&A	8.0
Master Caution Lights	U	2.5
Main Display Panel Center Station		(38.5)
Audio Panel	C&I	1.3
8 Day Clock	C&I	0.5
Indicator Light & Abort Light	U	0.7
Reaction Control System	U	7.0
Service Module Propulsion	U	7.0
Booster Situation Indicator	U	2.0
ECS - Gas Control	U	6.0
ECS - Liquid Control	U	6.0
Service Module Quad. Temp. Ind.		3.0
SCS Power Control		2.0
IFTS Scan Select		1.0
Loudspeaker		2.0
Main Display Panel System Management Station		(40.0)
Communications Control Panel	C&I	8.0
Antenna Control	C&I	3.0
Abort Light & Master Caution	U	2.7
Power Distribution	U	12.3
Fuel Cell Reactants	U	9.0
Cryogenic Storage	U	5.0
Main Display Panel Installation Provisions		(27.0)
Main Display Right Hand Console	U	(11.0)
Nuclear Detection Display		3.0
Installation Provisions		5.7
Lighting Control		1.0
Audio Panel		1.3
Main Display Left Hand Console		(12.0)
Installation Provisions		6.7
Lighting Control		1.0
Audio Panel		1.3
Boost Emergency, Earth Landing Sequencer Control		3.0
Electrical Provisions		(29.0)
Environmental Provisions		(9.0)
TOTAL CONTROLS AND DISPLAYS (to be brought forward)		227.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

COMMUNICATION AND INSTRUMENTATION

ITEM	CURRENT WEIGHT 3-1-63
IN-FLIGHT TEST (RIGHT BAY FORWARD)	(125)
Crew Readout Panel	3
Manual Test Unit	15
Comparator	12
Programmer	11
Stimuli Generator	24
Panel Assy	15
Installation Provisions & Connectors	5
In-Flight Test - GSE Electrical Provisions	40
CREW AREA CONTROLS	(15)
Manual Control - Three Axis	7
Manual Control - Translation & Thrust	8
TOTAL IN-FLIGHT TEST & CREW AREA CONTROLS	140
TOTAL CONTROLS AND DISPLAYS	227
TOTAL TELECOMMUNICATION	522
TOTAL COMMUNICATIONS AND INSTRUMENTATION	889

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

GUIDANCE & NAVIGATION

ITEM	CURRENT WEIGHT 3-1-63
GUIDANCE & NAVIGATION	
Lower Equipment Bay	
Inertial Platform	58.7
Sextant	12.0
Telescope - Scanning	9.0
Map & Visual Display	8.5
Display & Control - Navigation	31.5
Display & Control - Computer	15.0
Navigation Base	21.0
Computer	58.0
Power Servo Assy	29.0
Coupling Display Unit	15.0
Junction Box	11.0
Cabling - MIT	40.0
Cabling - NAA	16.3
Spares	40.0
Optical Base	19.0
Eye Pieces	5.0
Bellows and Adapter	15.0
TOTAL GUIDANCE AND NAVIGATION	404.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

STABILIZATION AND CONTROL

ITEM	CURRENT WEIGHT 3-1-63
STABILIZATION AND CONTROL	
Lower Equipment Bay	(178.0)
Rate Gyro Package	6.5
Body Mounted Gyro Package	10.5
Electronic Control Package - Pitch	28.4
Electronic Control Package - Roll	29.1
Electronic Control Package - Yaw	28.4
Electronic Control Package - Auxiliary	30.5
Display/BMAG ECA Package	29.8
Spare Gyro - BMAG (2)	2.0
Spare Gyro - Rate	0.8
Spare Plug-in Module	12.0
Supports	(12.0)
Electrical Provisions	(16.0)
Environmental Control Provisions	(27.0)
TOTAL STABILIZATION AND CONTROL	233.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

REACTION CONTROL SYSTEM

ITEM	CURRENT WEIGHT 3-1-63
REACTION CONTROL SYSTEM	
Propellant System	(85)
Tanks & Expulsion Devices	29
Plumbing, Fittings & Insulation	23
Valves & Regulators	21
Sensors	1
Supports	11
Pressure System	(65)
Tanks (4500 psi)	10
Plumbing, Fittings & Insulation	5
Valves & Regulators	39
Sensors	2
Helium	1
Supports	8
Engine System	(121)
Engines	115
Supports	6
Electrical Provisions	(23)
TOTAL REACTION CONTROL SYSTEM	294

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

ELECTRICAL POWER

ITEM	CURRENT WEIGHT 3-1-63
ELECTRICAL POWER	
Energy Source	(60.0)
Battery - Main (2)	36.0
Battery - Recovery (1)	18.0
Installation Provisions (Cold Plates)	6.0
Power Conversion	(119.4)
Inverter (3) & Control	105.0
Battery Charger & Controls	5.0
Installation Provisions (Cold Plates)	9.4
Power Distribution & Control	(172.0)
Power Distribution Equipment	
Circuit Breakers	6.0
Battery Controls	5.0
No. 1 and No. 2 AC Bus Control	15.0
DC Busses (Diodes, etc.)	10.0
AC Busses	5.0
Utility System Controls	15.0
Mounting Hardware	2.0
Sequencer	20.0
Right Hand Circuit Breaker Panel	13.0
Terminal Panels	5.0
Power Distribution Wiring & Provisions	40.0
Lighting Wiring & Provisions	5.0
Ground Power Provisions	6.0
Power Control Panel Connectors	3.0
Installation Provisions	22.0
Electrical - Common Utility	(78.6)
Utility Wiring and Circuit Components	20.0
Left Hand Circuit Breaker Panel	7.0
Umbilicals	35.1
Adapter Separation System	5.0
Launch Escape System Separation	3.5
Service Module Electrical Initiation	3.0
Installation Provisions	5.0
TOTAL ELECTRICAL POWER	430.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

ENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 3-1-63
ENVIRONMENTAL CONTROL SYSTEM	
Pressure Suit Circuit	(86.5)
Subcontractor Components	67.4
Ducting, Conn., Clamps, etc.	12.1
Gas Analyzer (NASA)	7.0
Water-Glycol Circuit	(49.7)
Subcontractor Components	27.7
Water-Glycol	18.4
Plumbing, etc.	3.6
Pressure & Temp. Control	(18.1)
Subcontractor Components	17.3
Ducting	0.8
Oxygen Supply System	(14.7)
Subcontractor Components	11.7
Plumbing	3.0
Water Supply System	(29.1)
Subcontractor Components	24.3
Plumbing	4.8
Subcontractor Common Items	(42.5)
Brackets, Plumbing, Elect. Wiring	17.9
Instrumentation	14.6
Radio Noise Filter Spec. Allowance	10.0
Supports	(10.4)
Electrical Provisions	(21.0)
TOTAL ENVIRONMENTAL CONTROL SYSTEM	272.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

EARTH LANDING SYSTEM

ITEM	CURRENT WEIGHT 3-1-63
EARTH LANDING SYSTEM	
Parachute System	(532.7)
Drogue Chute System	36.2
Drogue Disconnect Inst.	16.8
Main Cluster	412.5
Disconnect Main Cluster	9.7
Pilot Chute System	29.2
Sequence Control	23.3
Attach Provisions	5.0
Location Aids	(9.1)
Forward Heat Shield Release System	(16.0)
Electrical Pyrotechnic Initiation Provisions	(5.2)
TOTAL EARTH LANDING SYSTEM	563.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

USEFUL LOAD

ITEM	CURRENT WEIGHT 3-1-63
CREW SYSTEMS	(752)
Crew (3) (50, 70, 90, Percentile)	528
Pressure Garment Assy (3) (NASA)	90
Food	75
Food Containers	15
Personal Hygiene Equipment	23
Biomedical Instrumentation (NASA)	2
Medical Equipment	15
Chemical Disinfectant	4
REACTION CONTROL	(258)
RCS Propellant	258
ENVIRONMENTAL CONTROL	(151)
Lithium Hydroxide	112
Activated Charcoal	4
Containers for LiOH & Charcoal	6
Oxygen - Re-Entry	2
Water-Launch & Re-Entry Cooling	10
Freon	10
Water-Earth Orbit Cooling	3
Water - Drinking	4
SCIENTIFIC PAYLOAD	(250)
TOTAL COMMAND MODULE USEFUL LOAD	1411

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

SUMMARY

ITEM		CURRENT WEIGHT 3-1-63
WEIGHT EMPTY		7539
Structure	2491	
Electronics	151	
Reaction Control	597	
Electrical Power	1160	
Environmental Control	78	
Propulsion	3062	
USEFUL LOAD		2241
Reaction Control	835	
Electrical Power	482	
Environmental Control	208	
Propulsion	716	
BURNOUT WEIGHT		9780
MAIN PROPELLANT - MAXIMUM USABLE CAPACITY		45000
GROSS WEIGHT		54780

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

STRUCTURE

ITEM	CURRENT WEIGHT 3-1-63
STRUCTURE	
Basic & Secondary Structure	
Radial Beams	436
Internal Structure & Engine Compartment Closeout	45
Outer Shell	920
Fairing - Command to Service	210
Engine Support	41
Antenna Support Structure	30
Forward Bulkhead Including Ring	155
Aft Bulkhead	370
Separation Provisions	20
Tank Support Shelf	30
Insulation	234
TOTAL STRUCTURE	2491

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ELECTRONIC SUBSYSTEM

ITEM	CURRENT WEIGHT 3-1-63
ELECTRONICS SUBSYSTEM	
Communications	(72)
Antenna Dish	10
Antenna Gimbals	13
Antenna Deployment Booms	5
Antenna Coax Cabling	16
Antenna Coax Supports	3
Antenna Control Electrical Provisions	5
Antenna Locking Provisions	20
Instrumentation	(49)
Sensors	30
Electrical Provisions	14
Supports	5
In-Flight Test Provisions	(30)
In-Flight Test & GSE Electrical Provisions	30
TOTAL ELECTRONICS SUBSYSTEMS	151

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

REACTION CONTROL

ITEM	CURRENT WEIGHT 3-1-63
REACTION CONTROL SYSTEM	
Propellant System	(149)
Tanks & Expulsion Devices	58
Plumbing, Fittings & Insulation	17
Valves & Regulators	32
Sensors	6
Supports	36
Pressure System	(131)
Tanks (4500 psi)	19
Plumbing, Fittings & Insulation	6
Valves & Regulators	76
Sensors	7
Helium	3
Supports	20
Engine System	(179)
Engines	69
Reflectors & Insulation	110
Structural Provisions	(80)
Electrical Provisions	(58)
TOTAL REACTION CONTROL SYSTEM	597

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ELECTRICAL POWER

ITEM	CURRENT WEIGHT 3-1-63
ELECTRICAL POWER	
Fuel Cell Power System	(1074.7)
Fuel Cell Power Pack (Incl. Mount & Instrumentation)	733.5
Intermodular - Radiator Plumbing	12.0
Fuel Cell Module Mount Attach.	2.0
Fuel Cell H_2 System	
Subcontractor Components	126.2
Plumbing and Valves	3.0
Fuel Cell and ECS O_2 System	
Subcontractor Components	164.6
Plumbing and Valves	4.0
Water Glycol - Fuel Cell Heat Transfer System	7.0
Elect. Wiring - Supercritical Gas	13.0
Space Radiator (Outer Skin)	9.4
Power Distribution	(51.3)
Relays & Diodes	10.0
Power Switch	5.4
Motor Switch	1.5
Umbilicals	14.4
Wiring & Busses	15.0
Supports	5.0
Electrical Utilities	(34.0)
Command - Service Separation System	5.0
Adapter Separation System	7.0
Electrical Initiation of Pyrotechnics	12.0
Supports	2.0
Sequencer	8.0
TOTAL ELECTRICAL POWER	1160.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 3-1-63
ENVIRONMENTAL CONTROL SYSTEM	
Water-Glycol Circuit	(43.6)
Subcontactor Components	8.5
Plumbing and Hardware	4.4
Radiator Provisions	5.6
Water - Glycol	3.4
Supports	4.7
Space Radiator (Outer Skin)	17.0
Water Supply System	(7.5)
Subcontactor Components	0.6
Plumbing and Hardware	6.0
Supports	0.9
Oxygen Supply System	(3.4)
Plumbing and Supports	3.0
Subcontractor Components	0.4
Subcontractor Common Supports	(0.5)
Electrical Provision	(23.0)
TOTAL ENVIRONMENTAL CONTROL SYSTEM	78.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

MAIN PROPULSION

ITEM	CURRENT WEIGHT 3-1-63
MAIN PROPULSION	
Propellant System	(1455)
Tanks & Integral Doors	990
Tank Skirts	200
Plumbing, Fittings & Insulation	95
Valves	9
Quantity Indication	70
Mixture Ratio Control	12
Supports - Plumbing & Equipment	79
Pressure System	(941)
Tanks (4500 psi)	800
Tank Supports	30
Plumbing, Fittings & Insulation	24
Valves, Regulators & Heat Exchanger	49
Supports - Plumbing & Equipment	38
Engine System	(640)
Engine	640
Electrical Provisions	(26)
TOTAL MAIN PROPULSION SYSTEM	3062

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

USEFUL LOAD

ITEM		CURRENT WEIGHT 3-1-63
REACTION CONTROL		(835)
Usable Reaction Control System Propellant		790
Unusable Reaction Control System Propellant		45
ELECTRICAL POWER		(482)
Usable Supercritical Reactants		
Hydrogen (incl. 10% reserve)		48
Oxygen (incl. 10% reserve)		411
Unusable Supercritical Reactants		
Hydrogen		8
Oxygen		15
ENVIRONMENTAL CONTROL		(208)
Oxygen - ECS		208
PROPULSION		(716)
Main Propulsion Helium		99
Main Propellant Residuals		617
Trapped - System	225	
Trapped - Engine	67	
Mixture Ratio Tolerance	100	
Loading Tolerance	225	
TOTAL USEFUL LOAD (LESS MAIN PROPELLANT)		2241

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DETAIL WEIGHT STATEMENT

LAUNCH ESCAPE SYSTEM

SUMMARY

ITEM	CURRENT WEIGHT 3-1-63
LAUNCH ESCAPE SYSTEM	
Structure	(1071)
Tower Assy	269
Flow Separator and Skirt	297
Jettison Motor Skirt	94
Pitch Motor Structure	157
Nose Cone and Ballast Support	110
Attaching Parts	28
Tower Insulation	45
Skirt Insulation	26
Flow Separator Insulation	45
Ballast	(50)
Propulsion	(5259)
Escape Motor	4764
Jettison Motor	440
Pitch Control Motor	55
Electrical Power	(20)
TOTAL LAUNCH ESCAPE SYSTEM	6400

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DETAIL WEIGHT STATEMENT

ADAPTER

SUMMARY

ITEM	CURRENT WEIGHT 3-1-63
ADAPTER	
Structure	(2892)
Panels	1914
Frames	422
Thermal Insulation	556
Electrical Power	(76)
Separation System	(142)
TOTAL ADAPTER	3110